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Zero Retries is an independent newsletter promoting technological innovation that is occurring in Amateur Radio, and Amateur Radio as (literally) a license to experiment with and learn about radio technology. Now in its fourth year of publication, with 1900+ subscribers. Radios are computers - with antennas!

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Steve Stroh N8GNJ, Editor

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Web version of this issue - https://www.zeroretries.org/p/zero-retries-0163

Request To Send

Commentary by Editor Steve Stroh N8GNJ

Paid Subscribers Update

My thanks to **Doug Leber KF0PCW** for upgrading from a Monthly subscriber to Zero Retries to an Annual Paid Subscriber to Zero Retries this past week! In an email exchange, KF0PCW said:

> I'm a new ham but a longtime tutor teaching reading to dyslexic youngsters and teens. So many of my students are makers and tinkerers and hackers. I'm thrilled to learn more about how to expose them to this amazing hobby that can bring them joy and powerful skills.

I'm including KF0PCW's note here in hopes that other Zero Retries readers that are involved in similar activities (or might want to be) might wish to exchange ideas with him - see his QRZ page for contact info.

My thanks to **Prefers to Remain Anonymous 41** for being a **New Annual Paid Subscriber** to Zero Retries this past week!

My thanks to **Prefers to Remain Anonymous 42** for being a **New Paid Subscriber** to Zero Retries this past week!

Financial support is a real vote of confidence for continuing to publish Zero Retries.

Major Conference Countdowns

- **JARL Ham Fair 2024** in Tokyo, Japan on 2024-08-24 and 25, in *3* weeks!
- **Pacificon 2024** in San Ramon, California, USA on 2024-10-18 thru 20 in 11 weeks. Tina KD7WSF and I plan to attend Pacificon 2024 (which makes it "major" to us). I have offered to do a presentation about Technological Innovation in Amateur Radio, and (I *think*) my proposal has been accepted.

See the **Zero Retries Guide to Zero Retries Interesting Events** for additional events.

Late Publication Today

Apologies for late publication of this issue of Zero Retries, especially to those that like to read it as soon as it hits their inbox or RSS feed reader. One Zero Retries reader on the US East Coast told me that their early Friday evening routine has become to grab a beer and their tablet computer and settle into their favorite comfy chair to read Zero Retries. My apologies to that reader for a late "beer thirty" today.

I had completed a major article for this issue, but in the last few hours before auto-publication, I decided that article deserved more thought and time to carefully consider. Thus I brought forward the M17 article that I had planned for next week's issue into this week's issue and that needed some significant editing.

Store and Forward Podcast - Episode 3

Episode 3 of the Store and Forward (S&F) podcast, featuring Kay Savetz K6KJN and myself, has now dropped. Our cadence for new shows is "approximately twice per month", especially for the remaining few months of nice weather here in the Pacific North*wet*. K6KJN lives in the Portland, Oregon area and I live in the Vancouver, British Columbia

area. We are both “of a certain age” and have lived in the region long enough to be intimately familiar with how fleeting this wonderful summer weather is… so we won’t let the labor of love that is S&F dictate our summer.

The link goes to our brand new *Store and Forward website* - www.storeandforwardradio.org - *a podcast about the past and future of ham radio*. S&F is all thanks to K6KJN who is the brains, website builder, podcast producer, and uses their editing mad skilz for S&F. One gripe I have about other podcasts is poor or no show notes, so we both try to insure there are reasonable show notes for each episode. And for those that watch the video, I *will* be doing a better job of *my* video by the next episode - K6KJN has their video well dialed-in.

This episode is mostly K6KJN describing an epic fingers-bleeding week in Denver sorting through the Bob Cooper archives which have been donated to Internet Archive and Digital Library of Amateur Radio & Communications (DLARC). For those that understand the reference (in the context of Internet Archive), K6KJN was an “Away Team of One”… and bless them for doing that. Some of the “Coop” material has already made it into public access in DLARC.

Richard “Reverend Rick” Olsen N6NR is a Silent Keyboard

I’m sad to learn that Rick Olsen N6NR, also known as “Chaplain Rick”, is now a silent keyboard. I didn’t know N6NR well; my personal memory of N6NR was that he was *wicked smart* with deep technical background… but when it came to Amateur Radio, he happily shared his knowledge with those of us that weren’t as deeply knowledgeable about radio technology.

N6NR was Director of Engineering of US West NewVector (which became US West Cellular… or vice versa - I’ll just abbreviate it to USWC). In that position, he was the de facto ringleader of a small, merry band of Amateur Radio Operators within USWC and that gave the merry band “cover” for putting up three UHF 9600 bit regenerative repeaters on USWC towers in the Seattle metro area. Those repeaters became the core of the Puget Sound Amateur Radio TCP/IP Network. Some of the more interesting bits about these repeaters were that these towers were *owned* by USWC. Thus USWC Engineering department had carte blanche for “experimental systems” on those towers. Not to mention that as cellular quickly gained popularity, these towers had all of their cellular equipment moved down much lower on the tower to accommodate more aggressive frequency reuse, thus the upper half of the towers became largely unused. Those three towers originally covered *all* of the Seattle metro area (this was the *very* early days of cellular where the average cellular unit was at least 1 watt on 800 MHz).

The antennas originally used for the repeaters turned out to be designed with “uptilt” radiation patterns (for typical Amateur Radio Operators)… which wasn’t optimum at the top of a 300 foot tower… on hilltops. So the merry band decided to invert them and that worked great until they suffered water infiltration; despite reasonable waterproofing precautions, they weren’t designed to be used upside down. They went through a few antennas before they got that issue sorted out.

Another fun bit of detail was that the repeaters were repurposed Motorola Pulsar radios which were used for the original (pre-cellular) mobile telephone system on UHF. They were designed for full duplex and long duty cycles, living in a car trunk, at high power for good voice quality. Thus they were *rugged*. The “merry band” had no problems bypassing the need for a head unit, dialing down the power for tower service, putting them on Amateur Radio UHF repeater frequencies, and pulling out flat audio signals for the TNCs with the TAPR 9600 bps board with a bit regeneration adapter.

To provide a backhaul link to the three repeaters without needing yet another Amateur Radio radio on the tower (there were also 2 meter 1200 bps simplex radios as part of each repeater), the “merry band” connected the repeater’s computer (running KA9Q NOS) to a telemetry connection at (if memory serves) 19.2 kbps, thus it was possible to have very wide area data transfers from by accessing one of the repeaters and connecting seamlessly to a user on one of the other repeaters.

This was all fantastic fun for several years, but inevitably USWC was consolidated into bigger and bigger entities, and the towers were sold to a site owner that didn’t want Amateur Radio Operators on *their* towers (without paying full rent). N6NR and the merry band’s very valuable skills as pioneers of using Qualcomm’s CDMA technology were in intense demand in the exponentially growing cellular industry.

N6NR became Reverend Rick, and went on to lead a very happy life beyond his time as USWC Director of Engineering. I (and we in the Puget Sound Amateur Radio TCP/IP Group / Network) owe N6NR and the rest of the

merry band a debt of gratitude for their sponsorship of the repeaters that were the core of the network. I wasn't the only one that leveraged my knowledge from that network and its pioneering use of TCP/IP in Amateur Radio to further my professional career.

But, mostly, N6NR made it possible to have an enormous amount of Amateur Radio bleeding edge networking *technical* fun, and for that I'm personally grateful to him.

73, N6NR! I wish you clear channels and Zero Retries! de N8GNJ

…

73,

Steve N8GNJ

Leave a comment

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New 3600 bps Packet Radio Mode for Radios Without Flat Audio

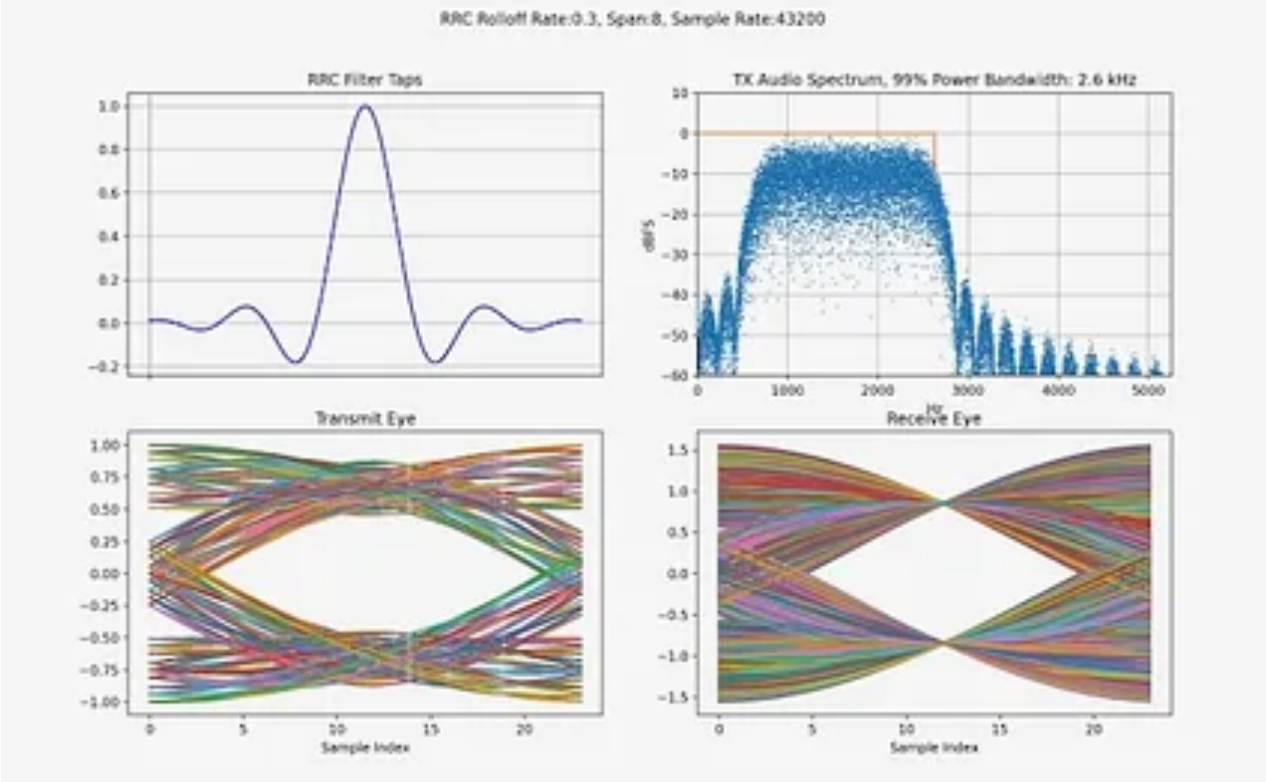
By Nino Carrillo KK4HEJ

Editor's Note *- Achieving maximum data speeds with a conventional VHF / UHF FM radio generally require using a radio that provides a "flat audio" connection such as the "9600" or "data" connector found on the Yaesu FTM-6000R1. A flat audio connection bypasses the radio's microphone pre-emphasis and speaker de-emphasis stages in the radio that make voice communications more intelligible. However, the pre-emphasis and de-emphasis stages distort higher speed data (audio) signals. Radios with flat audio connections are relatively rare in the mid-2020s. Until now, there were only a few data modes that were faster than 1200 bps Audio Frequency Shift Keying - AFSK that could be used with a typical radio's microphone and speaker connections. Thus for decades now, 1200 bps AFSK has been the default Amateur Radio data communications standard because it worked with every Amateur Radio VHF / UHF FM radio. Thus this new development, to be able to do reliable communications that are faster than 1200 bps, using radios without a flat audio connection, is very welcome.*

I'm pleased to welcome Nino Carrillo KK4HEJ, the primary developer of the NinoTNC, as a guest author in Zero Retries. The NinoTNC is a relatively new KISS TNC that's available as a "through hole components" kit, or an assembled and tested version.

I've been working on a 3600 bps mode for the NinoTNC. My goal was to make a mode that worked reliably through unmodified speaker/mic connections on FM voice radios, and moved data a little faster than 1200 AFSK.

The mode uses QPSK at 1800 symbols per second, applied to a 1650 Hz carrier tone. I use matched filtering on the I and Q channels in the modulator and demodulator to shape the occupied audio bandwidth and filter noise. Using an RRC filter with rolloff-rate of 0.3 results in a baseband waveform that fits through the audio filters of normal FM voice radios. Here's an image of my simulation of 1800 symbol/sec BPSK, which has the same audio spectrum as QPSK:



You can see the audio spectrum should fit in a normal 300 Hz to 3000 Hz voice channel.

It's worth noting that QPSK on the audio carrier does not result in an RF QPSK waveform after FM modulation. Similar to AFSK over FM, which is not RF FSK.

The bottom squares on the chart show the baseband waveform after the transmit RRC filter (bottom left) and after the receive RRC filter (bottom right). You can see the effect of the scheme "cleaning up" the received "eye" pattern, or removing inter-symbol interference.

The QPSK demodulator in the NinoTNC firmware implements a Costas Loop to sync the audio carrier and provide "coherent detection".

I have this working in NinoTNC firmware v3.39 (for 256k dsPICs) and v4.39 (for 512kdsPICs). It's mapped to MODE switch position 0101, replacing the old DPSK 2400 mode. In the NinoTNC, I use IL2P+CRC as the encoding method for this mode.

I've also been working with John G8BPQ to help him make a compatible mode in his qtSoundModem program. He and I have collaborated on similar efforts in the past.

There are a couple operators in the NCPACKET network who have tested this mode out on the air, as well as a few members of the OARC in the UK. Thanks to Tadd KA2DEW and Tom M0LTE for their help and support testing the mode on-air.

NinoTNC users can download firmware images with this mode here: https://github.com/ninocarrillo/flashtnc, switch to the "v39" branch to get this version. I still consider this “beta”.

GitHub - ninocarrillo/flashtnc: Firmware updater for N9600A TNCs

Firmware updater for N9600A TNCs. Contribute to ninocarrillo/flashtnc development by creating an account on GitHub.

https://github.com/ninocarrillo/flashtnc

For folks interested in generating their own RRC filter taps, I have a little open-source python utility:

https://github.com/ninocarrillo/rrc-gen

For folks interested in understanding any of the demodulation methods I use in the NinoTNC, they might check out my open-source pymodem software. It's an offline packet decoder that mimics some of the techniques I use in firmware. It can demodulate recordings of the 3600 bps mode, as well as other modes:

https://github.com/ninocarrillo/pymodem

The QPSK phase map I use for the 3600 mode is the same as the other modes in the NinoTNC, and can be found in the IL2P specification document:

https://tarpn.net/t/il2p/il2p-specification_draft_v0-6.pdf

Editor's Footnote *- KK4HEJ "buries the lede" a bit in not mentioning that all of the modes available on a NinoTNC can optionally use a new Forward Error Correction (FEC) protocol that he developed called Improved Layer 2 Protocol (IL2P). Use of FEC makes packet radio communications even more robust. Prior to IL2P, the only FEC available for Amateur Radio packet radio was FX.25 which "appends" an FEC packet to an AX.25 packet, thus not efficient or optimum, but it was FEC, and was compatible with AX.25. In contrast, IL2P is interleaved with the data packet making it (in my opinion) more robust and better optimized than FX.25. When using IL2P, all stations that are communicating must also be using IL2P.*

Kudos to KK4HEJ for this new mode for better data communications in Amateur Radio!

Why M17 Is Significant - Part 1

By Steve Stroh N8GNJ

Post publication update *- I knew that there would be an eventual update to this story, but I had no idea that so much, and such good information would be sent to me as a result of this article. Thus* ***Why M17 Is Significant - Part 2*** *is now available in* ***Zero Retries 0164****.*

This article is mostly derived from an email that I sent that was "an absurdly long answer to a short set of questions". A Zero Retries reader asked me (very tersely summarized), "Is the new Connect Systems CS7000 M17 really significant? And, by extension, "Is M17 actually a viable new Amateur Radio Digital Voice system for VHF / UHF?".

An Irreverent History Lesson of Digital Voice in Two-Way Radio

Why do we have digital voice in two way radio? FM was as good as it needed to be, right? Heck, we used FM for the comm channels on the Apollo *Moon* missions! Because back before cellular, two-way radio was getting really popular for business. Everyone wanted their own frequency, and if they couldn't get their own frequency, they wanted at least a less crowded frequency / trunked radio system so people could talk as necessary without waiting for others. Remember that at those times, television broadcasting was still dominant, and they were still irritated that the FCC had yanked UHF channels 70-83 away from television broadcasting and carved up that 84 MHz of spectrum 50% for public safety / commercial two-way, and 50% for the new cellular industry2. Television broadcasters said "Never again"… until the FCC came up with the novel measure of the HDTV cutover to compact broadcasting down into the lower end of television UHF.

So FCC (and as I understand it, simultaneously, ETSI) required by fiat that the two way radio industry - public safety and industry, convert their systems from 20/25 kHz channels to 12.5 kHz channels, with an evolution path to eventually move to 6.25 kHz channels. The technology of that era (three decades or so ago) couldn't easily do those kinds of narrow channels with analog (FM) techniques, so they decided that since everyone was paying big bucks for entirely new systems, they would pay a little bit more for the "benefits" of *digital* voice. That made doing 12.5 kHz channels a lot easier as you could get an understandable *digital* voice signal into 12.5 kHz and even into 6.25 kHz. Digital voice also made it a lot easier to manage fleets of radios because *every* DV radio transmitted a digital ID and if someone lost a radio, that ID could be de-authorized so it couldn't use the repeater / trunked radio system so the

thief couldn't do bad things with the stolen radio. Being digital theoretically made things possible like over the air updates (which has a checkered history, from the stories I recall).

Oh, and another feature of digital voice that was *very* attractive to public safety and especially US government (think security for military bases and nuclear plants) was the possibility of encryption. Doing real voice encryption in analog is hard (and pretty ineffective / easy to crack), but pretty easy when the voice is already digitized. All you need to do with a digital voice is scramble the order of the transmitted voice bits (and reassemble them).

Along the way, some company made the argument to the FCC (and apparently ETSI) that they could do the *equivalent* of 6.25 kHz channels by using Time Division Multiple Access (DMA) techniques to cram two independent voice channels into a 12.5 kHz channel. FCC and ETSI said "good enough" which is how we got (cheap) DMR.

But then cellular happened.

Cellular happened, at least the wild popularization of cellular in displacing two way radio and especially trunked radio partially because cellular could peanut butter their infrastructure costs across tens of thousands of users. In comparison, the average two-way radio system only had hundreds of users. Cellular was just that more efficient (and faster to change generations of technology) with their spectrum.

The (Payment) Problem With Digital Voice

Back three decades ago, in the early days of the "narrowband mandate" for two-way / trunked radio, some technical sharpies foresaw that there would need to be digital voice, and decided to get ahead of the curve and start patenting *all* conceivable approaches to doing digital voice over two way radio and cellular. And that approach worked. There were some fortunes made purely out of patent filings that were never implemented - they just got acquired for defensive purposes.

When TAPR first looked at trying to create a digital voice system for Amateur Radio, they did a very extensive study. Their conclusion was there was no way to implement digital voice that had not already had a patent on file. *Every* conceivable method. If you wanted to do digital voice over radio, you were going to have to pay royalties to *someone*. And the license terms were that you had to use their technology as a black box, with no understanding of how it worked internally, or tinkering with, your chosen DV technology. Just "bolt it in", use it, *don't ask questions*.

DMR with its 2 conversations in a 12.5 kHz channel is a creature of the narrowband mandate. D-Star is also a creature of the narrowband mandate, but the Japanese were more technically capable and were able to make 6.25 kHz channel radios, with a trickle of streamed data alongside the digital voice. "Everyone" accepted that using patented DV Coder Decoders (CODECs) *was just the price of having a digital voice two way radio system*.

Apologies in advance to K6BP and VK5DGR for this quick take on the creation of Codec 2. I'm sure that I've got details wrong in my telling that follows.

Fast forward a few decades from the digital voice patenting frenzy and Open Source advocate Bruce Perens K6BP decided that there ought to be an open source option for digital voice in Amateur Radio and connected with David Rowe VK5DGR to try to create an open source digital voice option.

VK5DGR did his own (new) study of the digital voice field and hit upon the novel idea of not trying to work around the "digital voice patent minefield" but rather take advantage of patented techniques *whose patents had expired*. He eventually developed Codec 2 which was a successful, usable digital voice CODEC that was entirely open source. Anyone could use it, anyone could hack it, improve it, etc. It's now in widespread use, notably in Amateur Radio as the core technology of FreeDV on HF, and M17 on VHF / UHF.

The creation of Codec 2 was the breakthrough that eventually made inexpensive, hackable, digital voice possible in Amateur Radio, and digital voice that could evolve in new systems, new capabilities, etc.

***Why* M17?**

Why M17? Especially why M17 when we have "perfectly usable" digital voice systems in DMR (and cheap!) and D-Star and System Fusion and even surplus P25 radios?

Several reasons, combined:

- Because we could - see below.
- Because we wanted to - see below.
- Mostly, because Wojciech (Woj) Kaczmarski SP5WWP decided to *try*.

Because we *could*… We now have fantastically cheap, fantastically powerful microcontrollers. How cheap? We're embedding processors with full TCP/IP stacks and Wi-Fi into *light bulbs*. Yep, we're now in the ludicrous position that some light bulbs boot up into (a heavily distilled) Linux OS. So what used to require an expensive, embedded, *proprietary* chip to do digital voice could *now* be done with a cheap embedded microcontroller. Thus we now had the raw capability to do cheap, good, open source digital voice that was just software. The hardware caught up with Codec 2 being implemented solely in software.

Because we *wanted to*... It took me a long time to understand this, but there is a sizable contingent in Amateur Radio that *hate, with a white hot passion,* modulation techniques that are not open standards. These folks don't think it's moral, fair, or perhaps even legal (though no one has really pushed that argument yet) for there to be transmissions over Amateur Radio spectrum that are proprietary… can't be hacked on… without paying someone to buy their proprietary technology. They argue that using proprietary systems on Amateur Radio goes against the spirit of openness in Amateur Radio, for experimentation, interoperability, fun, curiosity, learning, motherhood, apple pie, etc. Not just DVSI for patented digital voice chips, this white hot hatred against proprietary systems extends to Pactor 4, VARA HF and VARA FM, Robust Packet (though that's been kind of hacked), CLOVER, and others I'm forgetting.

Apologies in advance to all of the many folks along the way that contributed to M17 becoming a usable system. I wasn't able to find a comprehensive list of such folks to link to, and ***mentioning all of them is part of the story deserves to be told****, probably as part of an eventual book on M17. I'm sure that I've got details wrong in my telling that follows.*

M17 exists primarily because Wojciech Kaczmarski SP5WWP *decided to try*. He created M17 out of an *idea*. He was bright, capable, energetic, motivated, and had the requisite background to create M17 - *with lots of help along the way*.

First came a detailed specification. You only know that you did a good job with a spec when people read the spec and build their own independent system and it works and most importantly *interoperates* with the versions that other people build from the same spec. *By this measure, the M17 folks did a great job on the spec.*

For a long time, M17 existed as a mode on Internet linking of repeater networks via BrandMeister. Gradually *radio* hardware for M17 emerged like the Module 17 hardware and then modifying some radios to do M17 modulation. Mobilinkd got in on the M17 fun and included M17 data modes in their TNC3 and new TNC4. From my perspective, that was a powerful endorsement of M17 seeing it implemented in a plug and play product like the TNC 3 and 4. There was also ZUMRadio's MMDVM hotspots and MMDVM modems which included M17.

M17 really started to get some traction towards becoming a usable two way radio system (including repeaters) when it was included as just another digital voice mode in the Multi Mode Digital Voice Modem (MMDVM) project which has been implemented in dozens of different, independent hardware modems. That meant M17 was now available for use in MMDVM radio hotspots, MMDVM modems, and especially MMDVM modems that could convert FM repeaters into digital voice repeaters. Most people install MMDVM modems into repeaters to be usable by FM, and DMR, and D-Star, and SF users, but M17 is also in MMDVM now, so if MMDVM radios eventually emerged (which they existed, with Modem 17 connected to a "9600 capable" radio like Kenwood TM-V71A) and the OpenRTX modified radios, they could work through an MMDVM repeater.

Connect Systems CS 7000 M17 - The First "M17 Out of the Box" Radio

Which brings us to current day and the recent availability (past couple of weeks) of the first "off the shelf, built in from the factory" M17 radio from Connect Systems - the CS7000 M17 UHF Radio.

In these early days, some post-sale firmware updates are inevitably going to be required, but eventually all the early quirks will get worked out and it really will be usable out of the box.

Connect Systems committed to creating a new M17 radio, lined up the needed talent to develop it, committed the capital for the development costs and the initial order from the Original Equipment Manufacturer (OEM), and the willingness to evangelize M17 and carry the units in stock. The CS7000 M17 UHF Radio is now a *product*, not a "project". Thus the credit for Connect Systems having shipped the first "out of the box M17 radio" is well-earned.

Thus we now have all the pieces in place for those that want to put an *open source digital voice repeater system* on the air, and "buy them and use them" radios to use such repeaters. I've seen claims that there are 30'ish M17 repeaters on the air worldwide, but I haven't been able to find any additional details to refer to. In the US, the first such system I'm aware of, *that explicitly supports M17* (read the fine print), is the Mount Diablo Amateur Radio Club's W6CX-DV -- MultiMode Digital Voice Repeater.

Why Does All This Matter? The Big Picture?

One of the reasons to try / adopt M17 is once there's some real momentum, it's all open source so it can get improved, forked, hacked, extended, transmogrified, etc. No other Amateur Radio digital voice system is as well defined as M17 (that I know of), especially the sticky (patented) digital voice chip.

As I understand it, the M17 spec is written well enough that it's now theoretically possible (perhaps even done; apologies for not doing that research) to create a "module" (not sure what you call this - sketch?) to be able to do a software download into a Software Defined Transceiver for an M17 radio. In this era of Software Defined Transceivers and wicked capable and wicked cheap microcontrollers, M17 has the ability to develop rapidly to take advantage of SDTs and new microcontrollers.

Thus, imagine writing an "M17 radio" in GNU Radio:

Specification + Software + Software Defined Transceiver = working M17 radio.

Since such a thing would be implemented on a Software Defined Transceiver, which typically can operate on *all* the Amateur Radio VHF / UHF bands, there no reason M17 can't be used on other interesting bands like 10m, 6m, 2m, 1.25m as well as the default 70cm band.

Side Note re:Data on M17

The M17 folks were smart and aware enough to incorporate *reasonable data capability* in their spec[3] - you can even connect to an M17 radio (again, according to the spec) as a KISS TNC device and it will send data, including telemetry (APRS strings), short messages, and even file data transfers. None of the other digital voice systems did this so well, at least outside their proprietary systems. You can do data between MOTOTRBO radios, between Hytera radios, kind of send data between D-Star (using their barely supported DV Fast Data mode), and you can send photos (but no data) on System Fusion.

It won't be long before we're just doing digital voice + data on VHF / UHF as "just one of many modes", very much like selecting between FM and SSB on an HF / VHF / UHF radio. At the current rate of radio evolution, we're only a few years from that. So having a system like M17 with a solid specification, refined with actual hardware interoperability testing, that's designed for Amateur Radio, with no license or trademark or any other issues (because it's all open source) will become the default for such radio systems.

Is M17 by itself compelling enough to displace DMR or D-Star or SF? Probably not… *it depends*… ***maybe***… Which answer is appropriate depends on the *locals* and how much they want to have fun and experiment with something new like M17. Like everything else, if you can get someone(s) to charismatically lead such a project and make it look like you're having fun, *especially having more fun than the next group*, you'll get some folks who want to join the fun and play along.

All the rest of the digital voice systems are captive to the expectation - by their manufacturers and by their users, to the traditional hardware, traditional form factors, whatever China can mass produce and sell cheap, etc. We're getting cheaper DMR transceivers with more bells and whistles from China, but I don't think we're getting *better* DMR transceivers from China. And we're certainly not getting better and especially not cheaper D-Star and SF transceivers… just more expensive, and fewer choices, with maybe a few more features. So I'm guessing M17 will evolve faster than any of the other Amateur Radio digital voice systems *can* evolve.

The final, and best reason for M17 is that it's a new idea that's born within the past decade, and it's open source, which is beloved with this generation of techies and hackers. Thus M17 is going to be one of the ways of getting the current generation of techies and hackers interested in doing Amateur Radio VHF / UHF. Soon enough they'll be able to do it for cheap by loading it onto an SD transceiver, putting up their own micro repeaters, maybe even something radical like a mesh network of micro repeaters where the repeaters can listen to each other (you know, with a SD receiver or ka9q-radio) and if there's a user who wants to talk to someone who's a user of another repeater, the repeaters dynamically handshake (over the air or maybe over an Amateur microwave network) to set up a cross link for the duration of the conversation.

Repeaters the way we know them, and repeater coordination, and DV repeaters, and maybe even the IRLP and Echolink networks are products of an earlier era when radios were all hardware, modulation methods were hard coded and unchangeable, etc. We can do better now with current technology, and something I've observed about the current generation is that they don't feel beholden to past ways of doing things. They're not writing letters on paper with stamps, they're not even writing checks, they're not watching network TV or listening to broadcast radio, a lot of them that live in cities don't feel compelled to own a car, and don't feel compelled to talk on the radio.

M17 - The New Hotness

In conclusion, M17 has reached the stage that it can be considered "The New Hotness" in Amateur Radio VHF / UHF. While M17 remains *very much a work in progress*, especially building out wide area (or even local area) M17 infrastructure, that's part of the attraction for the newest generation of Amateur Radio Operators that are techies and hackers. M17 is a creature of the open source movement and this new generation will get to define it and change it and adapt it to their needs.

Thus, in comparison to the "*live with it* because that's the best we can do" approach of the incumbent digital voice systems which are well-deployed and well understood, aren't nearly as exciting.

Your opinions may vary.

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By Steve Stroh N8GNJ

Short mentions of Zero Retries Interesting items.

QST Reviews "Designed for Digital Modes" Radio… *Without Testing Digital Modes*

I generally don't mention anything published in ARRL publications since only the small percentage of Amateur Radio Operators that are ARRL members can see ARRL content behind its paywall, but the absurdity of this review was Zero Retries Interesting.

In my usual brief pass-through of QST, I discovered this review and thought "Oh, cool, a portable HF radio that is designed to operate digital (data) modes!":

BG2FX FX-4CR Portable Transceiver
Reviewed by Phil Salas AD5X
QST, 2024-08, pages 35-40

> **Overview**
>
> The FX-4CR transceiver is a compact and attractive transceiver that covers the 80 – 6-meter ham bands, along with a general-coverage receiver that tunes continuously from 3.5 to 54 MHz. The cast aluminum metal case has an excellent solid feel to it. And even though the FX-4CR can output up to 20 W of power, it literally its in the palm of your hand. A tiny microphone rounds out the unit. The FX-4CR also

> includes a built-in microphone for portable operation. And besides normal AM, FM SSB, and CW modes, *the FX-4CR is designed for digital modes*. A USB cable provides computer interfacing for digital modes as well as for firmware updates.

It was a good review, describing the experience of setting up the radio and some of its features. I read on eagerly to see how well it did for the reviewer on digital modes.

> **On the Air**
>
> I operated CW and SSB on 40, 20, and 17 meters, and CW on 30 meters, using my 43-foot vertical. *I did not test the FX-4CR on digital modes as I am primarily a CW and SSB operator.*

You *really* cannot make this stuff up!

Whitebox Smart Software Radio Device Project - The Rest of the Story

The Whitebox project was an ambitious attempt to create an open source Software Defined Transceiver in a handheld radio form factor around 2013-2015. The technology of that era was barely viable for attempting such a portable radio (without the resources of a multi-million dollar commercial company), and thus it was admirable to even *try*. Despite considerable progress as evidenced from a 2013 DCC paper, Github page, and even a Facebook page, the project just seemed to stop.

Now there's some closure on the Whitebox project from Bruce Perens K6BP, posting on LinkedIn:

> More than a decade ago, I was involved in the "Whitebox" radio project with Chris Testa KD2BMH. This was a project that would have created an Open Source and Open Hardware handheld software-defined transceiver. The prototype had a lot of digital noise and the project lost steam at that point. The M17 project has completed a number of our previous goals.
>
> Chris subsequently fell completely off of the internet and has not been heard of for years. He did so with some thousands of dollars of my equipment in hand, but that doesn't matter as much. He worked for several companies, but the online data on him seems to have petered out.
>
> During Hamvention, on the morning of my presentation, an anonymous person texted me from a number purportedly in Minnesota, and apologized for letting down the Open Source and Amateur Radio communities. I replied but there was no further communication.

In referring to M17, I think K6BP is referencing the OpenHT project:

> The OpenHT, at least in its Proof of Concept stage, is a complete QRP SDR handheld transceiver. It's built around the STM32F469I-DISCO board. Morgan ON4MOD designed an awesome RF shield for it. Some technical details behind the design:
>
> Duobander: 389.5 - 480, 2400 - 2483.5MHz (RX, TX frequency ranges are limited by your local laws) low RF power output: <14dBm (<25mW) complete I/Q transceiver allowing for virtually any mode (including M17 and FreeDV) the radio uses the AT86RF215 low-cost I/Q transceiver chip by Microchip/Atmel use of an FPGA (Lattice LIFCL-40) as the AT86<->STM32 interface allows to offload the MCU (FPGA does the DSP heavy lifting, all the way from RF stream to baseband) the radio will run a port of OpenRTX on it hardware is TAPR licensed Supported modes so far.

I haven't seen any recent progress on the OpenHT, but potentially it could be realized in this decade given the capabilities available now versus the Whitebox a decade ago:

- Like Whitebox, OpenHT is open source, so all the hard work can be shared.
- OpenHT uses current parts.
- There are a lot more, and better RF design tools available in this era. There's also a lot more "open source" RF design expertise available from there having been so many open source *radio* projects, such as the TAPR

TangerineSDR project, and the Universal Radio Test Instrument, to name just two.

- Crowdfunding the design process is feasible via Kickstarter, GoFundMe, Crowd Supply, etc., not to mention grants are available from ARDC for open source projects.
- There are competent and reasonably trustworthy, low cost, turnkey assemblers in China4.

I hope that OpenHT will actually become a product, not just a project. I think the new paradigm of building a portable radio that is *only* the battery system and radio, and using Bluetooth to link to a smartphone (or tablet) for the display and keyboard and audio is much more viable idea than doing all of that in one handheld device.

ARRL Executive Committee Meeting - FCC Counsel's Update on Symbol Rate Proceeding

Excerpt from the 2024-06-06 ARRL EC Meeting:

> **6. FCC Counsel's Update - David Siddall**
>
> Mr. Siddall provided updates on Washington matters and plans for future actions with regard to pending issues at the Federal Communications Commission (FCC).
>
> **Pending Petitions:** Multiple important petitions have been pending at the Commission for a number of years. Mr. Siddall and the EC discussed how to proceed on each of the pending ARRL petitions. Those of ARRL and others that address Part 97 changes have completed comment cycles, but none has received further action. A report will be made at the July Board meeting.
>
> Mr. Roderick expressed his dissatisfaction with the FCC's inaction on the ARRL petitions but also noted that the Commission's recent favorable action on the long-pending symbol rate proceeding offers hope. Nevertheless, given the most optimistic FCC timeline for addressing our key proceedings, it could be 2026 before we see final and hopefully favorable determinations.
>
> …
>
> **Follow-on symbol rate proceeding:** Comments and reply comments have been filed with regard to the remaining amateur bands that have symbol rate restrictions. Almost all comments favor deleting the restriction. The issue is now with the FCC staff for their consideration.
>
> …

It's surprising that in his report, FCC Counsel Siddall only referenced the potential for symbol rates to be eliminated. In its Reply Comments on this proceeding, ARRL said:

> ***Bandwidth* Limits Should be Deleted**

(Emphasis mine.) And that… is as much… *as little*… as we know at the moment about progress within the FCC on the symbol rate proceeding and the potential to eliminate ***both symbol rate and bandwidth restrictions*** on the US Amateur Radio VHF / UHF bands.

2026??? Sigh…

Some AREDN Network Metrics as of 7/1/2024

AREDN Ambassador and Zero Retries Pseudostaffer Orv Beach W6BI:

> Some metrics from the AREDN World Map as of 7/1/24:
>
> - Total number of visible nodes: 2295 (down from 2503 last month)
> - Percentage of nodes updated to latest production build: 48% (up from 35%)

- Percentage of nodes that are non-MIMO (mostly Bullets, AirGrids and AirRouters): .4% (down from 5.4%)
- Longest uptime: 1689 days: still KA6ECT-RM3-Pleasants-36-198-231
- Nodes with highest reported number of tunnels*:
- K6PVR-VC-TUNNEL-SRV: 35
  KI5VMF-OKLAHOMA: 29
- AA3JC-AC3-HATFLD-1 - 26
- KI7LXY-HAP-AC3 - 23

Who's running what?

- Mikrotik: 57.5% (up from 56.7%)
- Ubiquiti: 33.2% (down from 33.7%)
- TP-link: 1.6% (down from 2%)
- Gl.inet: 5.1% (down from 5.4%
- VMs (Virtual Machines): .35% (8) up from .3% (7)

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ka9q-radio Resources Page

Resources for ka9q-radio, such as where to get, how to install, how to configure and how it works.

What is **ka9q-radio**

ka9q-radio (Yes, by custom of the author, it is lowercase) is a attempt to move the data processing from dedicated hardware, move it into software on a CPU. The current radio is receive only. It uses a variety of USB receivers.

ka9q-radio is a very flexible system which require a time and effort to become competent in it use.

This document is designed to step you through the resources and the learning process.

What do you need to know?

The software runs on a variety of hardware configurations. Some receive tasks require very few physical resources. However some tasks require more receive and computer resources to process. **ka9q-radio** has two basic tasks,

1. First the **ka9q-radio** reads a data-stream from the USB 3+ port. The entire spectrum available is processed into a **iq**stream multiple times per second.
2. Second a separate process reads a specific location in the spectrum and decodes the signal protocol to either an audio or a digital format. Since these samples are small relative to the entire spectrum, **ka9q-radio** can sample hundreds of subsamples using multiple separate process in a multi-core CPU.
3. The **iq** samples can be processed locally or sent from one computer to another through the multicast network so the decoding can be completed on any number of other computers. Complicated configurations require more complicated configuration files.

This entire page, maintained by Dave Larsen KV0S is *distilled wisdom* like the above excerpt. This is “ka9q-radio for mortals” (which, in my opinion, previously required wizard-class skills). Even *I* can follow this info now and have a

reasonable chance at success in getting ka9q-radio going.

Kudos (again) to KA9Q and now KV0S for ka9q-radio and this valuable info!

WANslam - A Zero Retries Interesting Competition

From Ward Silver N0AX via email:

> The WiFi distance record reminds me that I have been imagining a combination licensed / unlicensed competition for sending data over wireless links. I call it the **WANslam** and the basic idea is for individuals or teams to try and send a data file over a wireless link with scoring being driven by distance, speed, bit rate, etc. There could be licensed and unlicensed categories. Although the two can't contact each other due to FCC rules, it would be a neat way for folks to learn about ham radio and interact with hams.

That… is a very cool and Zero Retries Interesting idea! That the scoring factors in *speed and bit rate* (and bandwidth?) makes it more interesting (to me) than the simple "we heard a signal" frequency + distance competitions.

YouTube - Two New Zero Retries Interesting (Shack) Battery Developments

These two separate YouTube videos reflect the incredible innovation in battery technology that's going on that's actually usable by the average Amateur Radio Operator. To date, most of the innovation in batteries for Amateur Radio has been for portable use because of the high energy / weight ratio (energy density) that makes it a lot more feasible to do portable operations with reasonable endurance. But those innovations have largely not been reasonably priced (or have high enough capacity) for "shack" usage. Until now.

The first is a 100 Ah Lithium battery that's reasonably priced:

The second illustrates that *solid state batteries* are (finally) available in the real world:

*Wow… and **Wow!***

Leave a comment

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Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) — In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with radio technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to everyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- ***Founding Members* who generously support Zero Retries financially:**
  Founding Member 0000 - Steven Davidson K3FZT (Renewed 2024)

  Founding Member 0002 - Chris Osburn KD7DVD (Renewed 2024)
  Founding Member 0003 - Don Rotolo N2IRZ (Renewed 2024)
  Founding Member 0004 - William Arcand W1WRA
  Founding Member 0005 - Ben Kuhn KU0HN

Founding Member 0006 - Todd Willey KQ4FID
Founding Member 0007 - Merik Karman VK2MKZ
Founding Member 0008 - Prefers to Remain Anonymous 14
Founding Member 0009 - Prefers to Remain Anonymous 19
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- Numerous Annual and Monthly subscribers who also generously support Zero Retries financially!

Want to Support Zero Retries?

- The *most* effective way to support Zero Retries is to simply mention Zero Retries to your co-conspirators that are also interested in knowing more about technological innovation that is occurring in Amateur Radio and encourage them to become a fellow subscriber.

- One particularly effective method of promoting Zero Retries is to add a mention of Zero Retries to your QRZ page (or other web presence) and include a link:

  https://www.zeroretries.org

- If you'd like to financially support Zero Retries, becoming a paid subscriber is *greatly* appreciated and helps offset expenses incurred in publishing Zero Retries. Paid subscriptions for Zero Retries are *entirely optional*, as explained in this special issue of ZR:
  Zero Retries Administrivia - Activating Payment Options.

These blogs and newsletters regularly feature Zero Retries Interesting content:

- Dan Romanchik KB6NU mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.

- Jeff Davis KE9V also mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.

- Amateur Radio Weekly by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories that often feature "Zero Retires Interesting" topics.

- Experimental Radio News by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC. It's a *must-read-now* for me!

- RTL-SDR Blog - *Excellent* coverage of Software Defined Radio units.

- TAPR Packet Status Register has been published continuously since 1982.

- Hot Iron - The Journal of the Constructor's Club is a delightful quarterly newsletter.

- Other Substack Amateur Radio newsletters recommended by Zero Retries.

These YouTube channels regularly feature Zero Retries Interesting content:

- HB9BLA Wireless by Andreas Spiess HB9BLA

- KM6LYW Radio by Craig Lamparter KM6LYW (home of the DigiPi project)

- Modern Ham by Billy Penley KN4MKB

- Tech Minds by Matthew Miller M0DQW

These podcasts regularly feature Zero Retries Interesting content:

- Ham Radio Workbench by George Zafiropoulos KJ6VU (and friends)

- Foundations of Amateur Radio by Onno Benschop VK6FLAB

Zero Retries is currently using the Substack email publishing platform to publish Zero Retries. It's particularly suitable for small newsletters as you can get started for no cost.

If you're reading this issue on the web and you'd like to see Zero Retries in your email Inbox every Friday afternoon, just click below to join ***1800+*** other subscribers:

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Offering **feedback or comments** for Zero Retries is equally easy — just click:

Leave a comment

If you're a fellow smart person that uses **RSS**, there *is* an **RSS feed for Zero Retries**.

Social Media:

Zero Retries (N8GNJ) is on Mastodon — n8gnj@mastodon.radio — just click:

Zero Retries / N8GNJ on Mastodon

Zero Retries (N8GNJ) is also on Bluesky — @n8gnj — just click:

Zero Retries / N8GNJ on Bluesky

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- SuperPacket blog — *Discussing new generations of Amateur Radio Data Communications — beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog — *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs — Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham (The City of Subdued Excitement), Washington, USA, and linked to the Internet via **Starlink *Satellite* Internet Access**.

2024-08-02

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Footnotes for this Issue

1

This radio is specified because it's currently in production and provides a flat audio I/O connection (without the extra cost of the Yaesu System Fusion capability which is irrelevant for data communications in this discussion).

2

There was also one 6 MHz channel that was reserved for public safety communications, which is an entire story in itself.

3

This is another big chunk of writing work for a future, detailed article about M17 *Data*, and inclusion in the eventual M17 book.

4

I have no idea who such "competent and reasonably trustworthy, low cost, turnkey assemblers" actually are… but there's ample experience within the small innovative Amateur Radio ecosystem of who the reliable vendors are.